CS550 Final Project

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Project Proposal:

My final project aims to create a realistic 3D animation of a rocket's journey from Earth to the Moon and back. The focus will be on implementing detailed texture mapping to render the Earth and the Moon, along with lighting techniques to create realistic shadows and illuminate these celestial bodies. The project will incorporate a downloaded obj file of a rocket and animate it using key-time animation.

My Project:

In this project, I created an animation of a UFO orbiting around the Earth and the Moon. By calculating the UFO's orbit around the Earth and Moon on "GeoGebra 3D Calculator" and using trigonometric functions to determine the necessary angle adjustments when the object turns, I obtained the corresponding values. Using Keyframes animation, this animation was then created. In the project, the 'l' and 'L' keys can be used to switch perspectives. One perspective clearly shows how the UFO orbits around the Earth and the Moon, while the other gives the illusion of sitting on the UFO and observing the surfaces of the Earth and Moon.

Differ from my Proposed:

My project differs from my original proposal in two ways. First, I replaced the rocket and flame's OBJ files with a UFO's OBJ file. This change was made when I realized that calculating the deflection angles for the rocket and its flame would take much more time than I expected. The rocket's flame needed to move in opposition to the rocket, so I couldn't simply apply the calculated rocket deflection angles to the flame. Therefore, I used the UFO with the already calculated rocket deflection angles to achieve the intended animation of the rocket orbiting the Earth and Moon.

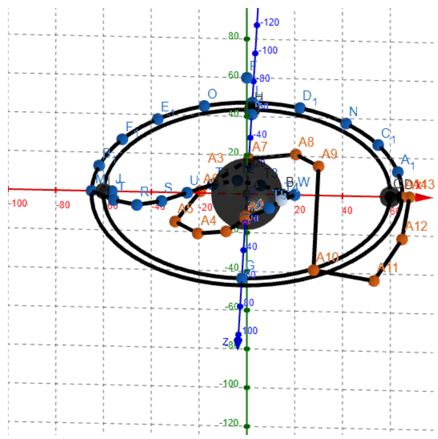
The second difference is that I didn't use lighting to create a day-night effect. When I tried to write the lighting, it caused the Earth's original colors to become dimmer, losing the effect of the original mapping texture. To enhance the visual appeal of my animation, I decided not to include lighting in my final project.

What I learned from doing Final Project:

From this project, I gained a deeper understanding of how to use mapping texture and key-times animation techniques. I learned how to change the position, size, rotation, look-at point, and lighting effects of objects at different times using key-times animation. Through extensive practice in this final project, I became more proficient in using these two techniques. However, due to the extensive time spent calculating the rocket's deflection angles, I couldn't incorporate key-times animation and shaders to create shadows of objects on Earth. Nevertheless, following this final project, I believe I have the skills to integrate this aspect into my future projects.

What I did from Final Project:

By marking the flight trajectory on GeoGebra 3D Calculator, the path of the object was visualized. Orange dots represent the trajectory of the UFO flying from Earth to the Moon, while blue dots indicate the UFO's trajectory while it stays near the Moon and then flies back to Earth.



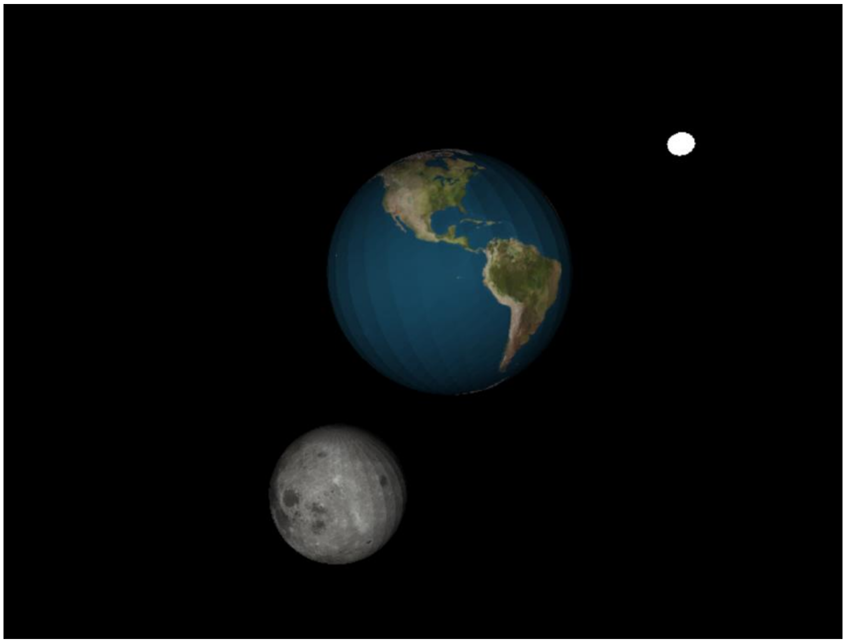
Calculate the rotation required for a UFO object in an OpenGL project to move from its initial position and orientation to a specified target position. The UFO object, initially at coordinates (0, 0, 18), was scaled by (0.7, 0.7, 0.7). The initial rotation set was (90, 1, 0, 0), indicating a 90-degree rotation about the x-axis. This orientation aligns the rocket along the y-axis. The target was to orient the UFO towards a new position at coordinates (-20, -10, 15), starting from its current position.

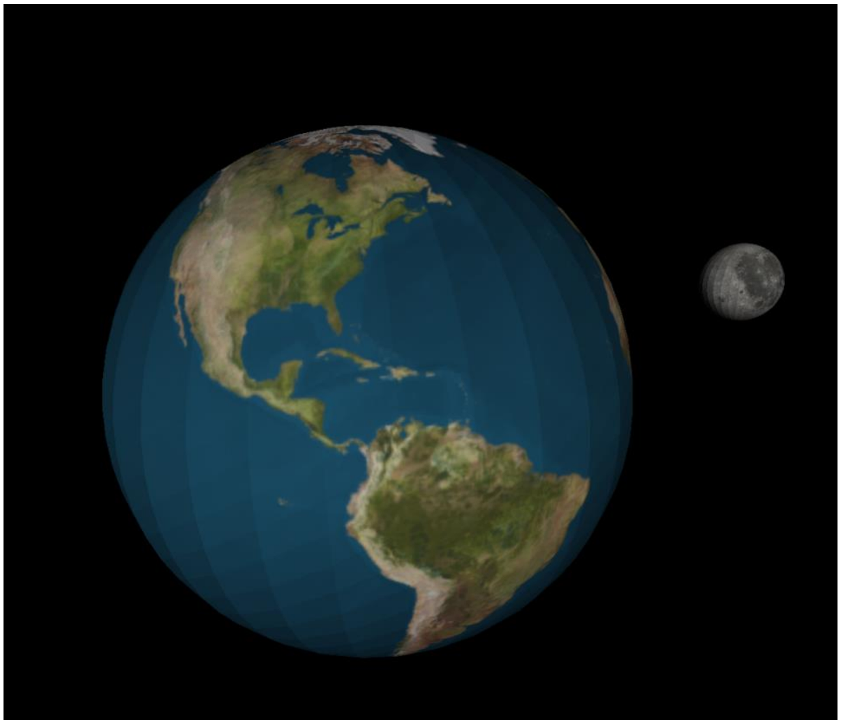
First, calculate the direction vector from the initial position of the rocket to the target position, D (target) = P (target) - P (initial). Then this direction vector is normalized to unit length, D (normalized) = D (target) / ||D (target) ||. Finally, the rotation axis is calculated as the cross product of the initial direction vector and the normalized target direction vector, A = D (initial) × D (normalized). Use the dot product of these vectors and the arccosine function to determine the angle of rotation, $\cos\theta$ = D(initial) × D(normalized), $\theta = \arccos(\cos\theta)$. Convert angles from radians to degrees. The computed rotation axis for the rocket to point towards the target position was approximately (-0.148, 0, 0.989). The angle of rotation required was found to be around 116.31 degrees.

To animate the UFO's flight, I input the coordinates, rotation, and scale of its trajectory at each time interval into the key-times animation. Then, I set the MSEC (milliseconds) value to 30000, which adjusts the total duration of my animation to 30 seconds. This approach allows for a smooth and continuous depiction of the UFO's journey around Earth and the Moon within a 30-second timeframe.

In my project, I enhanced the interactivity by incorporating the ability to switch the "Look at" point using the 'l' and 'L' keys on the keyboard. One perspective is set to look towards the center of the Earth (coordinates 0,0,0) from a position 120 units along the positive z-axis and 30 units along the positive y-axis. This viewpoint allows a clear view of the entire process of the UFO orbiting the Earth and the Moon.

The other perspective utilizes the moving path's coordinates as the viewing angle, but with an increased height along the y-axis. This adjustment provides a clearer view of the Earth and the Moon's surfaces as the UFO passes by. This dual-perspective approach enhances the viewer's experience by offering different vantage points to observe the UFO's journey.





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